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FLOOR HEATING SYSTEM WITH LATENT HEAT-ACCUMULATING MASS
[Fußbodenheizung mit Latentspeichermasse]

Ingeborg née Melchior Laing, et al.

UNITED STATES PATENT AND TRADEMARK OFFICE
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TITLE:	(54) :	FLOOR HEATING SYSTEM WITH LATENT HEAT-ACCUMULATING MASS
FOREIGN TITLE	[54A]:	FUSSBODENHEIZUNG MIT LATENTSPEICHERMASSE

The invention relates to floor heating systems in which latent heat-accumulating masses are employed instead of the previously used substances of high specific heat, such as, for instance, anhydrite. In floor heating systems, only slight excess temperatures can be used. Usually, temperature differences of 8 - 10° are anticipated. Therefore, in night-storage floor heating systems, the anhydrite layer heights amount to between 70 mm and 250 mm. This not only results in high costs and, in particular, also in transportation expenditures, but also in the need to construct the building premises differently from the start because the normal application height of a floor covering is only about 50 mm. The Patent Application 1604/1aP1928694.3 described floor heating systems in which latent heat-accumulating masses take the place of storage facilities for potential heat. /1*

The present invention represents an improvement of the mentioned invention and relates to special processes for producing these floors.

Thus, it has become evident that floor tiles for floor heating systems can be constructed advantageously by granulating the crystalline heat-accumulating substance and by then processing it in scourers or tumblers. The crystallites of undefined geometric shapes are first ground into globules in a first approximation. By

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*Number in the margin indicates pagination in the foreign text.

appropriately allocating globules of various diameters, an extremely dense packing can be obtained, so that globules in accordance with the invention with diamters between about 3 mm and 0.5 mm are intermixed in such allocations that a smallest possible gore volume remains between the globules. Then these globules of crystalline heat-accumulating materials are coated with a synthetic resin. A shaking process has proved to be most advantageous in which the globule layer /2
is saturated with resin; subsequently, the layer is shaken, so that points of contact between two adjacent globules which are created are temporarily interrupted and the resin layer enveloping the globules also covers the globules in these zones. By curing the resin, tiles are created which have an extremely high stability to pressure even if the globules themselves melt within the pore volume of the resin impregnation. Because all bordering surfaces are spherical and the remaining hollow spaces remain filled with an incompressible fluid even in a warm state, load values of several kp/cm^2 can be achieved which suffice for residential flooring. In accordance with this process, tiles can be produced in continuous strips which only need to be cut. Light-weight wood frames are advantageously laid into them and then the whole product is air-tightly packed with a foil, so that no moisture loss can occur, and, on the other hand, the ingress of air is also interrupted. Not only homogenous strips can be produced. This is because it has proved to be expedient to not only use heat-

accumulating masses of one single temperature, but to use heat-accumulating masses with various conversion temperatures which are different from the aspect of regulating them. In the simplest scenario, this is made possible by stacking the tiles that are made of layers of various masses with various recrystallization temperatures. In the event of extremely great heat requirements, all tiles are heated up in excess of the crystallization temperature. If the heating requirement is less, only two or, in marginal cases, even only one tile is heated up. This is made possible due to the fact that either heating elements with various heating capacities are used, or /3
because temperature sensors with a selectable switch-off temperature interrupt the heating process as soon as the desired number of layers has been charged. An additional alternative of the invention is that strips of various recrystallization temperatures are arranged side by side, whereas, alternatively, all strips or only those of the low temperatures, or of the low and medium temperatures are charged. When using this principle, it is also possible to design floor heating systems, so that they can be regulated, by charging only specific areas of the tiles by appropriately designing the heating element which heats up. To average the temperature on the surface, the heat-accumulating layer is then expediently covered by an aluminum tile. It is, for instance, also possible to divide a floor-heating tile in surfaces like a chessboard. If only 1/3 of the heat-accumulating tile

is latently charged, for instance, by only turning on the heating element areas under it, the average temperature of the tile, naturally, is a lot smaller than if 100% of the tile surfaces are charged. By dividing the heat-accumulating tile into individual areas with the same or, preferably, different fillings, in accordance with the invention, the floor tiles can be regulated with regard to the heat that is given off within broad limits.

The invention in accordance with the principal patent, among other things, provides that the active heat layer is accommodated in individual tiles which are supplied with power independently of each other. This, however, mandates the prerequisite that each tile has its own heat sensor, as well. The present invention proposes to replace individual heat sensors with one single or a few heat sensors which cause the switching off if the temperature rises to an /4
impermissible degree in any place of the room. This, e.g., is possible if the floor is hindered in it heat dissipation by heat-insulating coverings in some places. In order to prevent this, the invention provides that a long, thin-walled, thin tube be laid out over the tiles meander-shaped. This tube carries a diaphragm body on one end which actuates the off-switch. A liquid, e.g., water, is located inside the tube and, in addition, a body is located inside it which experiences a substantial change in density at a predefined temperature, e.g., wax with a defined melting point. If wax melts in

any location of the tube, the filling of the tube experiences a volume increase which is transferred to the diaphragm body, so that the off-switch is actuated.

Figure 1 schematically depicts the configuration of the heat-accumulating tile. A wooden frame (1) encloses the actual heat-accumulating tile (2) which is comprised of a plastic foam. After the heat-accumulating tile has been framed, the entire tile is enveloped with a foil (3) which is heat-sealed along the seam (4).

Figure 2 shows the principle of the configuration of the plastic foam in which globules of dissimilar diameters are jointed at such a quantitative ratio that the gore spaces remaining between the globules take up the smallest possible volume.

Figure 3 depicts the structural makeup of a tile comprised of /5
longitudinal strips of which each first one (30) crystallizes at a low temperature, each second one (31) crystallizes at a medium temperature, and each third one (32) crystallizes at a higher temperature, respectively. An aluminum tile (33) which is arranged below the heat-accumulating mass strips averages the heat of the subjacent planar heater (34) which is shown at a distance to the tile for clarity. Depending upon the heat-up time, first, the mass (30) which crystallizes at the lowest temperature is charged, then the mass (31) is charged, and only after that, the mass of the strips (32) is charged.

Figure 4 shows an arrangement in accordance with the invention in which the tile only contains one heat-accumulating mass; the subjacent heater, however, is divided into various heating circuits as shown by Fig. 5.

Figure 5 shows the configuration of the heating system for the tile in accordance with Fig. 4 in which the parallel heating circuits are distributed in chessboard fashion. By only turning on the heating circuit (50), a uniform, low temperature can be achieved on the floor, for instance. If all three heating circuits (50, 51, 52) are turned on, this maximum temperature is obtained. Advantageously, a metal tile is provided on the surface of the heating tile (40) to average the temperature.

Figure 6 depicts a heated floor in which the excess temperature guard in accordance with the invention causes the disconnection of the heating system as soon as an excessive temperature is created in any location along the tube (60) which is laid out in a meander shape.

Figure 7 shows the configuration of this guard. Apart from a /6
pressure-transferring fluid, e.g., water, a strip of a mass (70), e.g., wax, which strongly expands at a predefined temperature, is arranged inside the tube (60). This wax which collects in the upper part of the tube after the melting process, as shown by Fig. 8, expands by about 10 - 20% in those locations in which the melting temperature is exceeded. A diaphragm body (71) is located at the end

of the tube which interrupts a switch (72) as soon as the maximum permissible temperature is exceeded by a predefined minimum, e.g., the span of an individual tile, at any location of the tube.

Patent Claims

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1. Flooring with a latent heat-accumulating mass in accordance with Patent Application 1604/1a/P1923694.3 which is periodically heated by an electric resistor heater and with a supporting body which takes up the static loads which provides the heat-accumulating mass with sufficient stability in a charged state, characterized in that the heat-accumulating mass in the form of globular bodies is embedded in a hard plastic layer.

2. Heat-accumulating tile for floor heating systems in accordance with Claim 1, characterized in that the heat-accumulating mass globules (20) do not touch each other.

3. Heat-accumulating tile for floor heating systems in accordance with Claim 1, characterized in that the globules (20) have very different diameters and the globule packing has a very small gore volume.

4. Heat-accumulating tile for floor heating systems in accordance with Claim 3, characterized in that the volume of the plastic material constituting the supporting frame is less than 5% of the volume of the entire tile.

5. Production process for heat-accumulating tiles for floor heating systems in accordance with Claim 2, characterized in that salt granulate is tumbled in tumblers and afterwards topped up into layers, and then poured with plastics in their liquid phase.

6. Production process for heat-accumulating tiles, in accordance with Claim 5, characterized in that, after the introduction of the plastic material in its liquid phase, such a vigorous shaking process is initiated that the plastic mass penetrates between the contact zones of adjacent globules. /8

7. Heat-accumulating tile for floor heating systems in accordance with Claim 1, characterized in that heat-accumulating tiles are comprised of strips (30, 31, 32) which contain heat-accumulating masses of various crystallization temperatures.

8. Heat-accumulating tile for floor heating systems in accordance with Claim 1, characterized in that heat-accumulating tiles consist of squares, whereas adjacent squares exhibit various melting temperatures.

9. Heating system for floor tiles in accordance with Claim 1, characterized in that the heating system is divided into various circuits which are arranged in the form of strips and switched in such a way that the entire surface is heated selectively, or unheated strips remain between the heated strips.

10. Guard to prevent excessive temperatures in floor heating systems in accordance with Claim 1, characterized in that it possesses a tube (60) which is filled with a fluid which acts upon a diaphragm body (71) which actuates a switch (72) and that, in addition, a body (70), e.g. wax is located within the tube and over the larger portion of the length of the same which experiences a great change in volume during melting.

Fig. 1

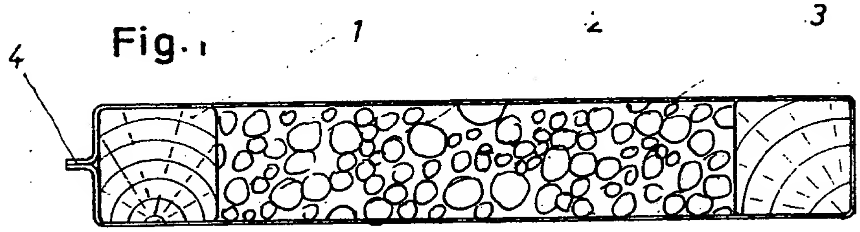

Fig. 2

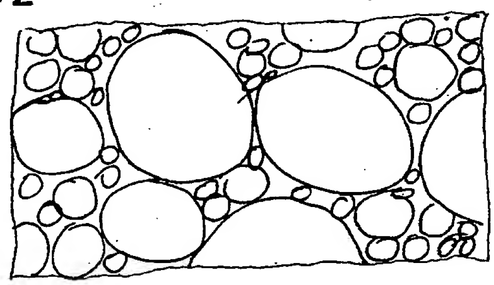

Fig. 3

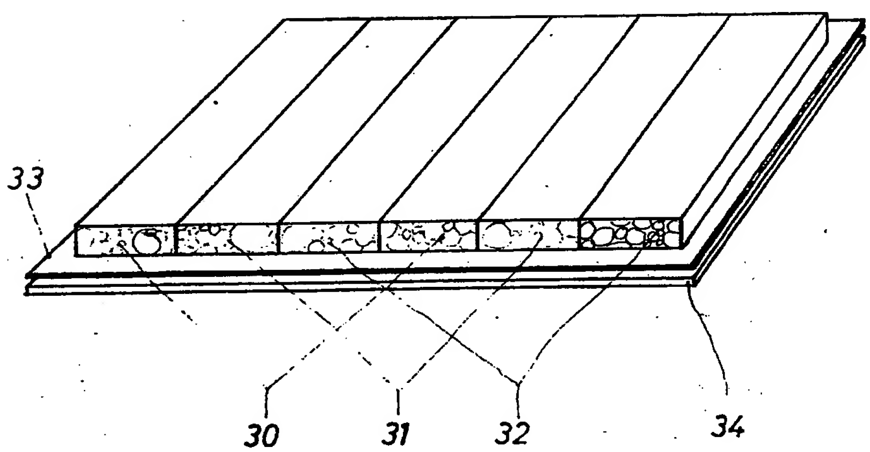

Fig.4

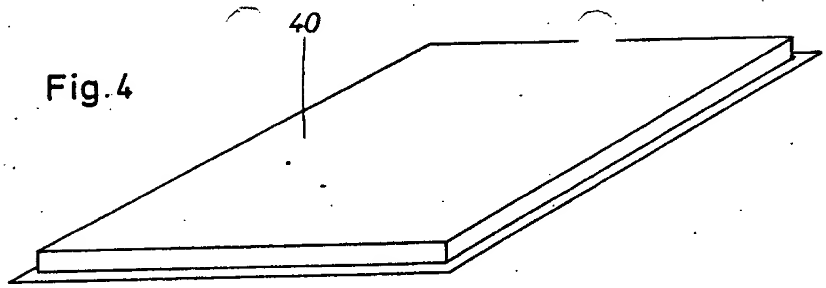

Fig.5

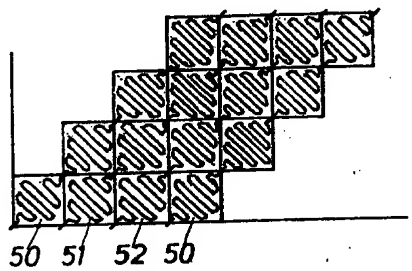

Fig.6

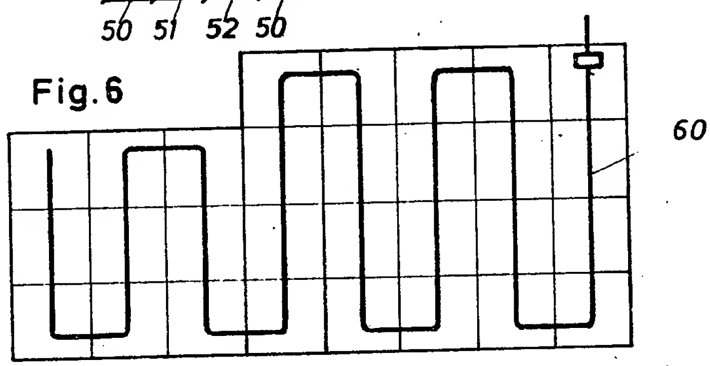

Fig.7

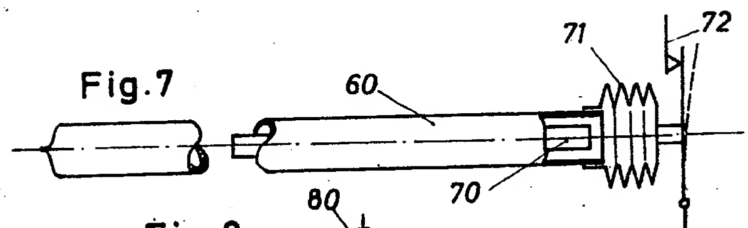

Fig.8